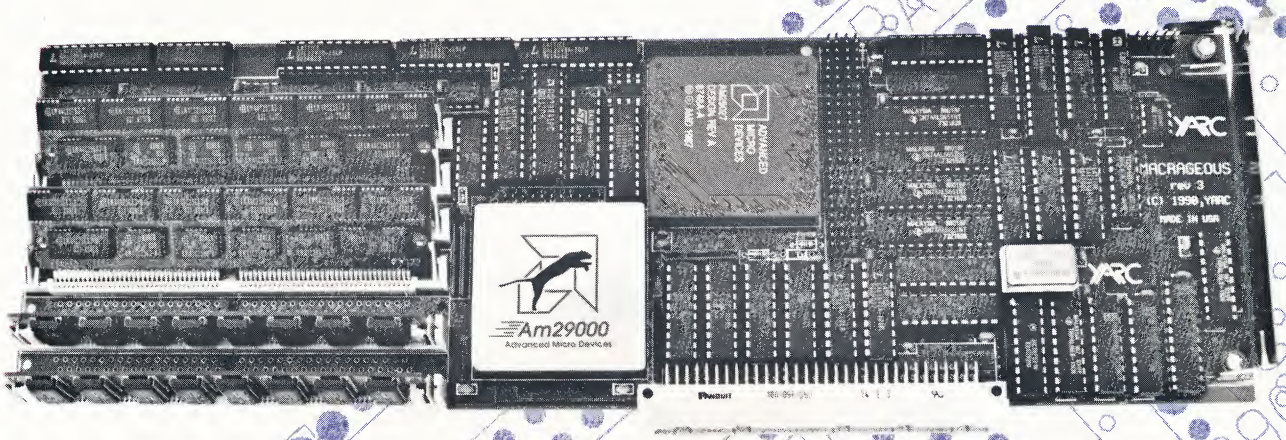
VG.
2 mflops, 64K

YARC

Yarc Systems Corporation

MacRageous

Macintosh-II RISC Coprocessor System



FEATURES:

- Am29050/29000 advanced 32 bit RISC CPU with separate data, instruction and address busses
- 30 MIPs peak performance, 24 MIPs sustained
- Up to 32 megabytes of high speed Dynamic Data memory
- Up to 2 megabytes of high speed Static Instruction memory
- Interleaved BURST mode for zero wait state performance
- 40,000 Dhrystones Integer performance
- Uses Macintosh operating system, coprocessor operates transparently to the user
- Operates under MULTIFINDER for a background computational role. Up to 4 Macrageous can be run concurrently in the one Macintosh host
- Master Mode gives full direct access to other 32bit NuBus peripherals
- Full software support via YARC's developer hotline, (818)889-4581

Even though you didn't ask, YARC = Yet Another Ruddy Coprocessor

GENERAL

The MacRageous™ combines the computing power of RISC technology with Macintosh™ convenience. Without leaving the environment of the Mac FINDER™ you can now accelerate compute intensive applications beyond the speed of mainframes. Direct access to graphics and other I/O cards in the NUBUS makes the MacRageous an ideal computing engine for scientific and engineering number crunching and graphical workstations.

The MacRageous uses the standard software interface defined for the Am29050 by its manufacturer, AMD. Thus code developed on the MacRageous under the Macintosh operating system will run on embedded systems and other YARC coprocessors, for example the PC/AT and VME cards.

YARC supplies Topexpress Fortran, the Metaware™ C compiler, the Macintosh operating system runtime interface, and tools including a macro assembler, linker and debugger.

WARRANTY

Thirty day money back guarantee if not completely satisfied (for prepaid orders). Software Support Available. One year limited warranty on parts and labour

SOFTWARE

Computer Supported	The MacRageous is designed for the standard Macintosh II computer. A hard disk is mandatory. Supports color, monochrome or high resolution display adaptors.
Operating System	The Operating System is the standard Macintosh FINDER. MULTIFINDER™ may also be used, with the disk I/O latency determined by the application running in the foreground mode.
Multiple Processors	Using MULTIFINDER more than one MacRageous can be operated in each host computer. Each MacRageous can directly access the memory of the other MacRageous and peripheral/graphics boards in the NUBUS, in addition to the memory on the 68020 motherboard. Each MacRageous continues to run, even if its operating window is downsized and switched to the background.

HARDWARE

CPU	Am29050/29000 operating at 20,30,33MHz, 30 nsec min cycle time
FPU	Am29027 Floating Point Coprocessor, optional.
Dimensions	Conforms to Macintosh II slot form factor.
Power Requirements	5 Volts +/- 5%. The card draws 20 watts (max), dependent on the configuration and executing software.
Expansion Connector	Expansion connector allows external hardware to be closely coupled to the MacRageous, facilitating prototyping of dedicated 29050 systems.
Construction	High reliability eight layer printed circuit board. Special bypass capacitors under chips enhance reliability and minimize RFI radiation.
Operating Environment	0 to 50°C

YARC Systems Corporation, 27489 West Agoura Road, Agoura Hills, CA. 91301, (818)889-4388

RISC COPROCESSORS

What Is A Coprocessor?

YARC designs and manufactures coprocessor boards for the Macintosh II, IBM AT compatible, and PS/2 computer systems. These boards are complete computers, in that they have their own CPU, memory, and operating system separate from those of the computer host. The coprocessor boards do not have their own peripherals such as disk drives, keyboards, and monitors. All I/O functions for a program executing on the board are provided by the host. A YARC coprocessor board allows users access to much higher performance (typically 5-20 times) than is available through their host micro-computer. This performance is provided at a fraction of the cost of workstations or mainframes. Additionally, the user retains the familiar micro-computer platform with its associated expansibility, user interface, and software base.

The performance increase comes from two key areas. The first is the advanced CPU and hardware design used in the coprocessor system. The second is that the coprocessor board is an additional dedicated computer system running only the user's program. All of the operating system overhead remains with the host computer. Programs not only run faster, but the user also has almost all the host computer resources still at their disposal.

AT-Super and NuSuper

YARC's highest performance coprocessor boards are based upon the Advanced Micro Devices 29000 (AMD 29K) RISC CPU. This chip has gained popularity in the controller and workstation markets, and has one of the best price/performance ratios of any CPU in production. Some of the basic features of the AMD 29K are:

- ➢ full 32-bit, three-bus architecture
- ➢ 23 million instructions per second (MIPS) sustained at 33 MHz
- ➢ concurrent instruction and data accesses
- ➢ 192 general-purpose registers
- ➢ 512-byte Branch Target Cache
- ➢ CMOS technology

The AT-Super is designed for PC/AT-compatible computers using 80286, 80386, or 80486 CPU's. The AT-Super runs under the control of PC- or MS-DOS. The NuSuper is designed for the Macintosh II line of computers. Both boards can act as bus-masters and therefore access host memory or other peripherals directly.

Performance

Figure 1 shows the performance of YARC's 29K-based coprocessor boards compared to several micro-computer and workstation platforms. These figures are taken from an independent review by MIPS magazine (October1989 issue). The board tested was the 25 MHz NuSuper system with a floating point unit. YARC now offers this board in a 30 MHz configuration, which boosts system performance by 20 percent.

Applications

The coprocessor systems use a different CPU than the host, and so standard commercial software for the host will not run on the coprocessor board. Software must be recompiled to run on the AMD 29K. The typical users of these coprocessor boards include:

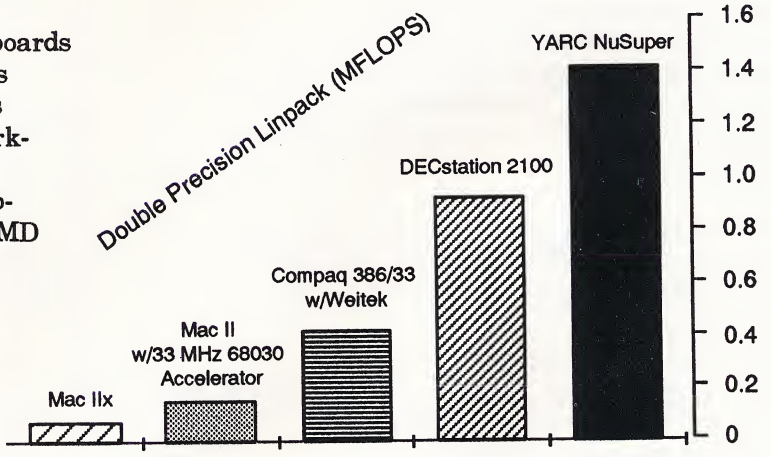


Figure 1. Floating Point Performance Comparison

- *Researchers in academia and business*
  These users get the highest performance for the least financial outlay. This performance is immediately accessible--no waiting for mainframe batch jobs.
- *Developers in the personal computer market*
  Modern high-end software packages often require more processing power than a standard microcomputer can provide. Developers can bundle a YARC board with their software to offer a computing solution which out-performs workstations and is relatively independent of the performance level of the host PC. Additionally, software ported to the AT-Super requires minimal changes to run on the NuSuper. This greatly reduces the effort necessary to provide and support packages to both the PC and Macintosh markets.
- *Developers in the mainframe/workstation market*
  By porting software to a YARC coprocessor, these developers can move into the PC marketplace without sacrificing performance. Software running on the coprocessor is also not affected by host operating system limitations (e.g. the 640K DOS memory limit).
- *Developers of 29K embedded products*
  YARC provides a mature development system on a familiar platform. Software for 29K-based products can be written and tested prior to or during hardware development.

YARC Systems currently supplies coprocessor systems to a variety of developers who bundle the board with their software solution. Some of the applications that currently run on YARC boards include:

- 3-dimensional modelling and photo-realistic computer imaging
- PostScript processing for high-end printing
- image processing
- geologic data analysis
- color pre-press processing for photographic images

Hardware Design

The basic hardware design for the 29K systems is shown in Figure 2. The system has three internal 32-bit buses (Address, Data, and Instruction) in a configuration known as a Modified Harvard Architecture. For a detailed description of this architecture, please refer to Trevor Marshall's article, "Real World RISC's", in Byte magazine (May, 1988).

This architecture allows the CPU to perform simultaneous instruction and data fetches. The CPU first issues the address of the instruction that it needs to fetch. This address is latched by external address logic. During the time needed for the instruction to become valid on the instruction bus, the CPU can also start a data fetch. An additional design feature of the board is the interleaving of instruction RAM, which allows it to operate at high execution speeds. The instruction RAM occupies two different RAM banks which are interleaved, so that two sequential locations are actually in different banks. When the CPU fetches one instruction, the next instruction is also fetched. Instructions can therefore be fed into the CPU with zero wait-states at a rate of 40ns/cycle while using standard 80ns dynamic RAM.

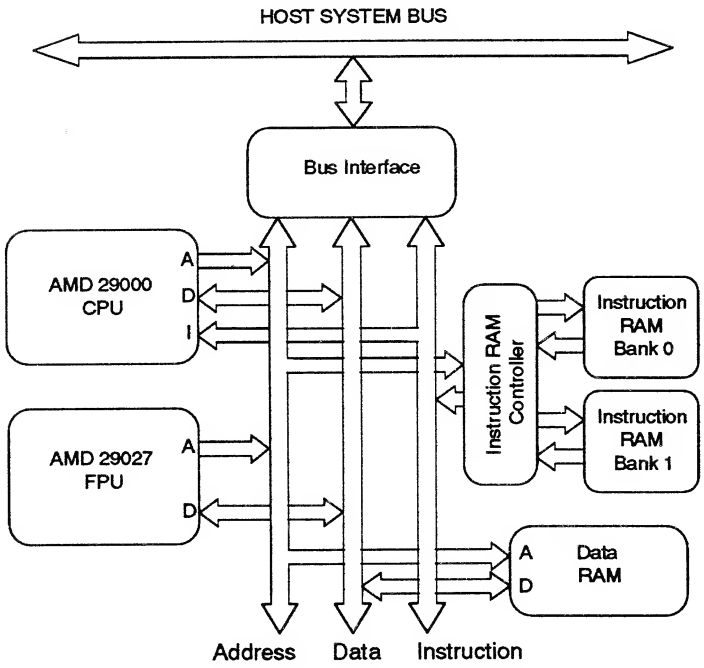


Figure 2. Coprocessor Hardware Design

Both the AT-Super and the NuSuper may be expanded with daughter cards. Daughter cards can be used for specialized operations such as driving laser printer engines or for data acquisition. YARC provides information for the design of daughter cards by the user. Additionally, YARC can be contracted to design daughter cards for custom applications.

Programming

The design goal for the NuSuper/AT-Super product lines is to provide the highest performance while minimizing the additional programming effort involved. Programs running on the coprocessor board have full access to standard host I/O functions. This is accomplished through an executor/loader program which translates requests for I/O operations from the board into host-specific calls. A program running on the board does not need to "know" that it is running on a coprocessor board. The program can make all of the standard C or Fortran file or screen I/O calls, which will be executed transparently by the host.

A diagram of the host/board software interaction is given in Figure 3. The programmer interacts with the coprocessor board through an executor program running on the host. On Macintosh systems, the user opens up a shell application (the **29K Executor**) which controls interaction with the board. Menu selections allow a variety of operations, including loading an executable file, running a program, setting board modes, bringing up a compiler command line, and halting and resetting the board. The compiler command line allows the programmer to specify files for compilation and linking. Executable files compiled for the NuSuper may be run simply by "double-clicking" on their icon. The **29K Executor** runs under MultiFinder, and so program executions (including compilations) can be performed in the background while standard Macintosh applications run in the foreground.

For PC systems, there are a number of programs which allow all of the above operations. For example, typing

```
29K prog.out
```

in response to the DOS prompt will cause the executable file "prog.out" to be loaded onto the AT-Super and begin execution. From that point on, the program appears exactly as a DOS program, only executing many times faster. With multitasking operating systems, such as MicroSoft Windows or DesqView, the user can operate the board as a background task.

YARC also provides developers with an interface package on both the PC and Macintosh systems. This interface allows developers to have the user-interface portion of their application running on the host, while main processing occurs on the coprocessor board. Transparent (to the user) access to high-speed processing lets developers market products in both standard and accelerated versions with no changes in interface or documentation.

Multiple coprocessor boards can be used for increased performance. While the boards are not specifically designed for parallel processing, they can be very useful for concurrent processing. For example, different stages of an image processing operation can be running on different boards, with the boards communicating through their bus-mastering capabilities. Likewise, multiple versions of a program can be run for increased throughput (e.g. VIDI, a Macintosh software developer, uses multiple boards to handle separate frames of a ray-traced animation).

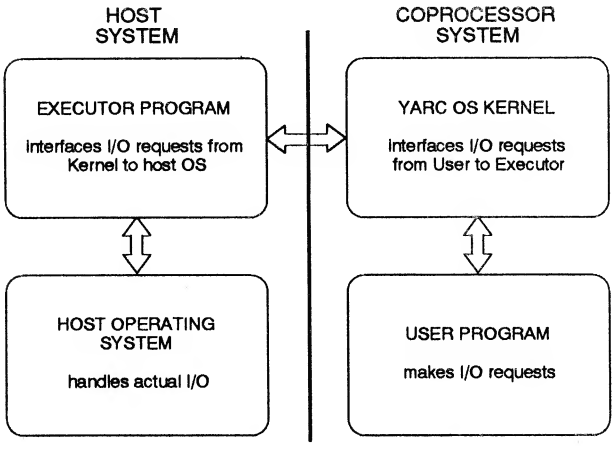


Figure 3. Software Operation

Development Environments

YARC offers two compilers for its 29K line of coprocessors. These are the MetaWare High C compiler and the YARC/TopExpress Fortran 77 compiler. Both these compilers run native on the

board, and so are not limited by the host (e.g. the 640K DOS limit). All editing functions are carried out on the host using whatever tools the user is most comfortable with (e.g. Wordstar, McSink, etc.).

The High C compiler complies to the ANSI standard, while additionally supporting a number of extensions. Some of these are listed below:

- local and global optimizations
- lint-like checking during compilation
- function prototyping for parameter passing specification
- arguments may be supplied by naming the function parameters rather than positionally
- ranges in case statements
- declarations and statements in any order
- support of "pragmas" for compilation control

The Fortran 77 compiler includes a complete set of common VAX and IBM extensions. These include:

- NAMELIST
- LOGICAL*1 and *2
- INTEGER*1 and *2
- COMPLEX*16
- INCLUDE files
- WHILE loops
- Block DO and DO WHILE
- Hexadecimal Constants
- Non-integral array subscripts
- Bit manipulation functions
- Compatible with C and assembler
- 132 column source lines

In addition to the compilers, YARC also offers an assembler and a debugger for use with the board. The source-level debugger allows setting breakpoints, tracing source execution, and viewing and modifying global and local variables.

Support

YARC provides both end-users and software companies with excellent technical support. All YARC products come with a 30 day money back satisfaction guarantee. This allows the testing of YARC products without risk. In addition, the systems are covered by a one year warranty on parts and labor.

More Information

To get more information about YARC's line of coprocessors, please contact us directly:

YARC Systems Corporation
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Agoura Hills, CA 91301
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Fax: (818) 889-2658

If you would like to read more about our products, we can suggest the following articles:

"A Calculating RISC"
Byte Magazine, May 1990.

"Coprocessor Board Provides Blazing CAD/CAM Performance"
MacWorld Magazine, May 1990.

"NuSuper Gives Supercomputer Performance on Mac"
MacJapan Magazine, January 1990.

"YARC's 29000 Makes the Mac Soar"
MIPS Magazine, October 1989.

"Worth The RISC"
Byte Magazine, February 1989.

"Real-World RISCs"
Byte Magazine, May 1988.

"Standard DRAMs Get 15 MIPS From RISC"
Electronic System Design Magazine, Dec. 1988.